

الاسم:
الرقم:مسابقة في الثقافة العلمية
مادة "علوم الحياة"
المدة: ساعة واحدة

Answer the following questions.

Question I (5 pts)

Once inhaled, cocaine reaches the brain in six or seven seconds: this is the "flash". The effects are first of all an increase in the arterial pressure, with an acceleration of heartbeats. Then, tremors, headaches with nausea, diarrhea, and also pulmonary disorders follow. All are accompanied with psychic symptoms such as the feeling of euphoria, absolute power, hyperexcitation, and finally hallucination. These symptoms last between fifteen and thirty minutes and disappear gradually in one or two hours. This mechanism can be explained by the neurobiological effects of cocaine, which disturbs the operation of the neurons of the brain, particularly those which produce dopamine, a neurotransmitter that is associated to the feeling of pleasure. Indeed, the consumption of cocaine inhibits the recapture of dopamine. Thus, the nerve impulse circulates continuously between the different neurons, creating, at the same time, an uninterrupted pleasure. However, when the blood concentration of cocaine decreases, dopamine is recaptured; the nerve impulse disappears, and the addict returns to life reality. He pushes, without hesitation, to take the drug in order to recover his state of continuous pleasure.

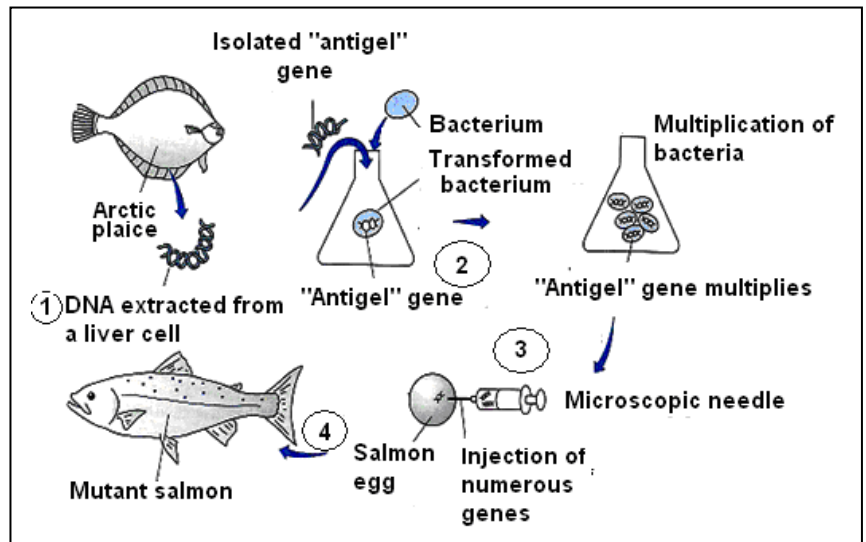
- Pick out from the text the symptoms provoked by the consumption of cocaine.
- Based on the text, justify the relation between cocaine and the feeling of uninterrupted pleasure in a drug addict.
- Mention two consequences common to the consumption of all drugs. Pick out from the text a sentence that justifies one of the two consequences.

Question II (6pts)

A fish species, called the arctic plaice, is equipped with a valuable gene (antigel gene), which is responsible for the synthesis of an antifreeze protein that enables them to resist very low temperatures. On the other hand, salmon die when the temperature decreases below 0°C. For that, researchers wanted to equip salmon with the savior antifreeze gene.

The opposite document shows how a "mutant salmon" is produced in the laboratory.

- Write a short text describing the done experiment.
- The term "mutant" used to describe the obtained salmon is not proper in this case. Propose another term that better describes that salmon. Justify the choice.
- What new characteristic will the "mutant salmon" acquire?

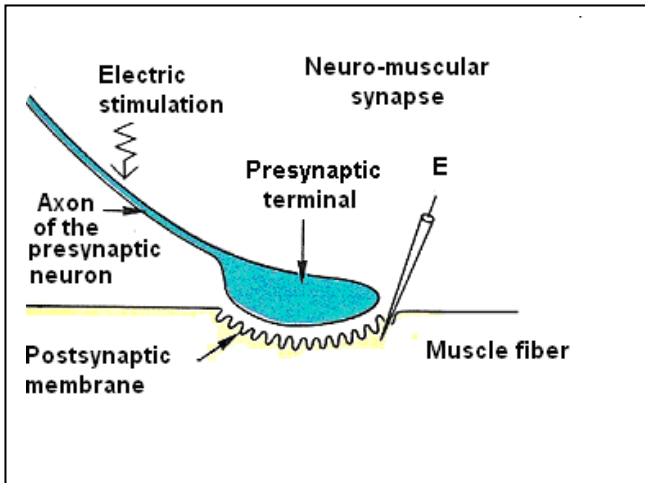


Question III (4pts)

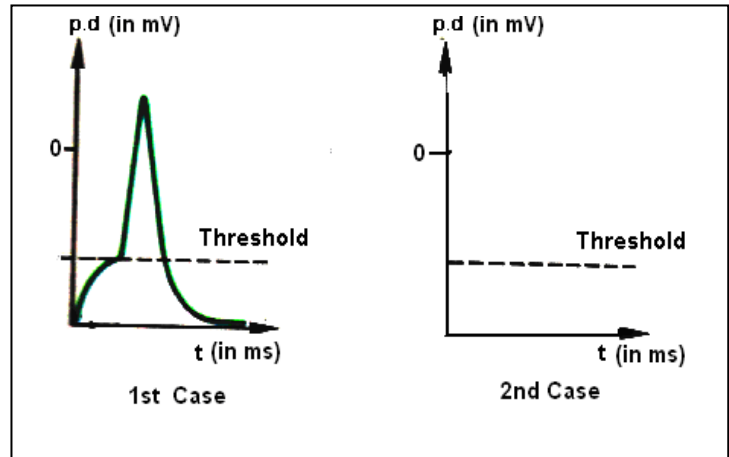
In the framework of studying the transmission of a nervous message at the level of a synapse, we prepare the experimental setup shown in document 1. We stimulate the presynaptic axon and do the recordings by an electrode E placed at the level of the postsynaptic membrane. Document 2 reveals the results obtained in two different cases:

1st case: Effective stimulation of the presynaptic neuron.

2nd case: Effective stimulation of the presynaptic neuron, preceded by an injection of a chemical substance, curare, in the synaptic cleft. This substance has a high affinity to acetylcholine receptors. Acetylcholine is a neurotransmitter that intervenes in a neuromuscular synapse.



Document 1



Document 2

- What does the obtained recording reveal in each case?
- Explain the obtained results.
- Determine the role of acetylcholine and the action of curare at the level of this synapse.

Question IV (5 pts)

In the framework of studying the role of the pituitary gland in a reaction of stress, we do the following experiments:

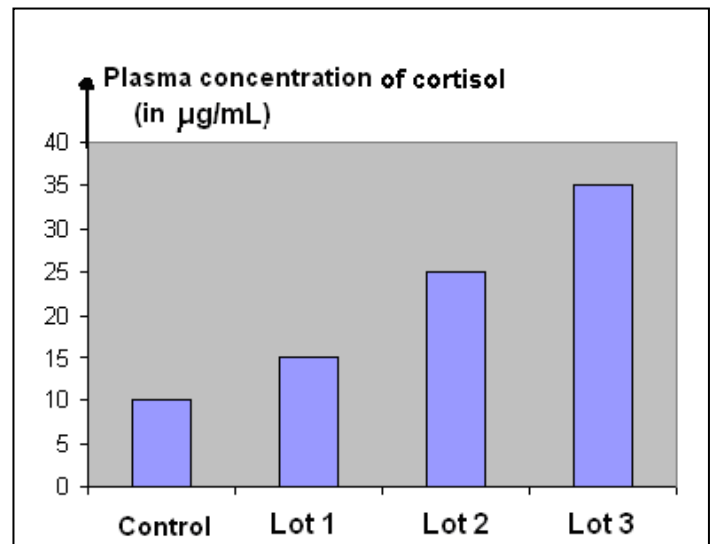
1st Experiment: We subject three lots of mice to increasing states of stress by placing each lot under different conditions of living. We measure the plasma concentration of cortisol, a hormone produced during stress by the adrenal cortex of these mice. The results are shown in the opposite document.

- Analyze the results obtained by the 1st experiment. Pick out the effect of stress on the adrenal cortex.

2nd Experiment: We perform the same experiment on mice who are subjected to the ablation of their anterior pituitary. The results of measurements revealed a very low concentration of plasma cortisol in the three lots of mice.

3rd Experiment: We inject a hormone, ACTH, extracted from the anterior pituitary, into the mice of the second experiment, and put them back under the same conditions of living. The results of measurements are the same as those obtained in the 1st experiment.

- Interpret the results of the 2nd and 3rd experiments.
- Name another hormone liberated in case of stress.



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Question I (5pts)

- a- The symptoms are: increase in the arterial pressure, acceleration of heartbeats, tremors, headache with nausea, diarrhea, and pulmonary disorders. **(1 pt)** All are accompanied with psychic symptoms such as the feeling of euphoria, absolute power, hyperexcitation, hallucination. **(1pt)**
- b- Cocaine prevents the recapture of dopamine, a neurotransmitter that is related to the feeling of pleasure. Thus dopamine causes nervous messages to circulate continuously between the different neurons, which leads to an uninterrupted pleasure. **(1pt)**
- c- Dependence and tolerance or addiction. **(1pt)**
He pushes, without hesitation, to take the drug in order to recover his state of continuous pleasure. **(1 pt)**

Question II (6pts)

- a- We extract the DNA from the liver cells of the arctic plaice fish. After the antigene gene is isolated, we introduce it into a bacterium. The transformed bacterium multiplies and consequently the antigene gene also multiplies. With a microscopic needle, we inject many genes in a salmon's egg and we obtain a "mutant salmon". **(3pts)**
- b- A transgenic salmon. **(1 pt)** Because the mutant salmon comes from an egg which had been subjected to the transplantation of a gene from another species. **(1 pt)**
- c- The mutant salmon will be able to face cold. **(1 pt)**

Question III (4pts)

- a- In the 1st case an action potential has been recorded ($\frac{1}{2}$ pt). In the 2nd case a resting potential is recorded or no action potential is recorded. ($\frac{1}{2}$ pt)
- b- In the 1st case, and after the stimulation of the presynaptic neuron, acetylcholine has been released into the synaptic cleft. It fixes itself on the postsynaptic receptors and provokes an AP. **(1pt)**
In the 2nd case curare fixes itself on acetylcholine receptors and prevents this latter from intervening in synaptic transmission. That is why no AP has been provoked. **(1pt)**
- c- Acetylcholine has an excitatory role ($\frac{1}{2}$ pt) and curare has an inhibitory action. ($\frac{1}{2}$ pt)

Question IV (5pts)

- a- The plasma concentration of cortisol is $10\mu\text{g}\cdot\text{mL}^{-1}$ in the control mice. This concentration increases to become $15\mu\text{g}\cdot\text{mL}^{-1}$ in lot 1 and continues to increase with the state of stress to become $35\mu\text{g}\cdot\text{mL}^{-1}$ in lot 3. Since cortisol secretion depends on the state of stress, we can say that stressful conditions activate the adrenal cortex that responds by increasing the secretion of cortisol. **(2 pts)**
- b- The ablation of the anterior pituitary reveals that in the different conditions of stress the plasma concentration of cortisol is very low. On the contrary, the injection of ACTH, the hormone secreted by the anterior pituitary, stimulates the secretion of cortisol again. Therefore, the presence of the anterior pituitary provokes the secretion of cortisol by the mediation of ACTH hormone that it secretes. **(2pts)**
- c- Adrenalin. **(1pt)**